

6575

**DE-WATERING TEST DATA  
AND ACTIVITY REPORT**

*Prepared for*  
**Brown & Root, Inc.**  
Houston, Texas

**March 1992**

**EcoTek**

ADMIN RECORD

A-DU04-000370

**DE-WATERING  
TEST DATA AND ACTIVITY REPORT**

*Prepared for*

**Brown & Root, Inc.  
Houston, Texas**

*Prepared by*

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1219 Banner Hill Road  
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**March 4, 1992**

**ROCKY FLATS DE-WATERING**  
**TEST DATA AND ACTIVITY REPORT**

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## 1.0 INTRODUCTION

This testing and data collection operation was performed by EcoTek, Inc., under contract to Brown and Root (P.O. # 031-2904-S-0006) to provide information concerning the filterability/de-watering characteristics of the Rocky Flats Solar Pond sludge. Data pertaining to the characteristics of these sludges is critical to the sizing and configuration of equipment for the de-watering of this sludge. Pre-treatment additive testing allowed EcoTek an opportunity to document reactions to the various additives available. Because sludges have a tendency to vary, the more preliminary information that is obtained, the better these variances may be handled on site. Laboratory analyses will also provide the information on the material handling characteristics of the Solar Pond sludge, which is also critical to process design and control.

## 2.0 EQUIPMENT DESCRIPTION

There will be two types of test equipment used to perform these tests. The first type uses a Model 075 EIMCO test press (see Figure 1). This test press consists of a chamber fitted between two drainage sides, which hold the filter media against the chamber. The test press is connected to a pressure vessel that can hold a 500 ml sample. A nitrogen cylinder and regulator are connected to the pressure vessel providing the means to force the sample through the test press. Pressure is increased 50 psig every five minutes to a maximum pressure of 225 psig. If the initial 500 ml sample is completely filtered before the test press cycle is full, additional 500 ml samples are loaded into the vessel until the test press cycle is completed. Completion of a test press cycle can be indicated in two different ways, time and filtrate discharge. If the test time is longer than a feasible field cycle time, the test is stopped and an alternative method used. If the filtrate discharge volume is low, the test press cycle is either complete or the method was ineffective. Data recorded during the test will be time, filtrate quantity, filtercake percent solids and filtrate quality.

The second type of test apparatus used will be a Baroid Model 30101 filter press. This will be referred to as the "test bomb." This device consists of a frame holding a three part cylinder with support screen and filter media. A 100 ml sample is loaded into the cylinder and pressure is applied to the cylinder with nitrogen, similar to the test process described above. Filtrate is released from the discharge nozzle, located on the bottom of the cylinder. This device is used as a preliminary step, with which different treatment additives can be quickly evaluated. This provides a good indication of which treatment chemicals will work best in the test press, minimizing overall testing time. Time, filtrate quantity and filtercake percent solids are recorded as data.

### 3.0 TEST DESCRIPTION

The sludge de-watering test began on Tuesday, February 25, 1992, in the treatability lab at NUS Pittsburgh. The sample was received in the lab then thoroughly mixed and a small aliquot taken for a solids determination. The pulp density of the raw sludge was 2.8 percent. To better represent the proposed process of pond consolidation the sample was given a one hour settling period and the supernate decanted off the top. The pulp density, after settling, was 7.9 percent and the volume was reduced approximately 70 percent. This left about one and one-half gallons of material to use in the de-watering tests.

The initial test was performed on un-treated sludge in the test press, to determine if the material would de-water with out any chemical additives. The filtrate discharge was slow from the start of the test, producing only 140 ml of filtrate in 65 minutes and a filtercake of 23 percent solids. The cake was very wet and did not completely fill the test chamber. The filtrate quality was poor, with visible suspended solids. Attachment 1 shows the data log and a graph from this test.

On Wednesday, February 26, 1992, using the test bomb, two NALCO polymers were identified that produced cake with good dewatering characteristics. The data was recorded and is presented in Attachment 2.

Several other "jar tests" were performed which did not produce any significant reactions. These chemicals included a high molecular weight high charge coagulant and a high molecular weight high charge anionic polymer.

On Thursday, February 27, 1992, the chemical additives identified on the previous day were tested, using the test press and a nylon 45 cfm filter media. The first chemical additive tested was a 0.5 percent solution of NALCO #7139, a high molecular weight *intermediate* charge cationic polymer. This solution was mixed with the sludge at a dosage of 200 parts per million, which produced a precipitate ("floc"). Four 500 ml batches of the treated sludge were required to complete the test run. The cycle lasted 65 minutes, producing 1,385 ml of filtrate from 1,650 ml of treated sludge. The filtrate quality was good, with no visible suspended solids. Cake produced was 35.4 percent solids which is below the minimum requirement of 50 percent.

The second test used the same filter media and a 0.5 percent solution of NALCO #7194, a high molecular weight *high* charge cationic polymer. The solution was mixed with the sludge at a dosage of 280 parts per million, which produced a "floc." Additionally, diatomite filter-aid was added to this sample at a dosage of 6 g/l to increase the amount of solids present, since there was only a small quantity of sample sludge remaining and the press may not have been completely filled without these additional solids. Four 500 ml batches of the treated sludge were required to complete the test run. The cycle lasted 95 minutes producing 1,540 ml of filtrate from 1,710 ml of treated sludge. The filtrate quality was good, with no visible suspended solids. The cake produced was 48 percent solids which is 2 percent below the requirements. Toward the end of the test, filtrate flow became steady and the "floc" sludge appeared to be de-watering in the pressure vessel. This was verified when the vessel was opened and the contents removed for measurement; there was a large lump of partially de-watered material in the vessel. Apparently, the "floc bodies" were large enough and plastic enough to obstruct the 1/2" diameter tubing and actually began to de-water prior to reaching the test press.

Based upon prior de-watering experience, we believe that this problem can be overcome using larger tubing and a positive displacement pump and does not reflect

adversely on the test results. Therefore, a filtercake with a pulp density of 50 percent can be achieved using the NALCO #7194 polymer.

Data from these two tests were recorded and are presented in Attachment 3. The Test 3 graph shows that the cycle was complete at 65 minutes as in the previous test. The break in the filtrate curve corresponds to the beginning of de-watering in the transfer lines and pressure vessel.

#### 4.0 CONCLUSIONS AND RECOMMENDATIONS

EcoTek feels that a higher quality filter cake is still achievable. Complete testing and pretreatment optimization could not be performed due to the small amount of raw sludge provided for testing. Higher pulp densities (greater than 50%) should be achievable with further testing and positive displacement pumping equipment.

EcoTek lab tests showed that a 0.5 percent solution of NALCO #7194 polymer applied at 280 parts per million achieved a nearly acceptable 48 percent pulp density. There are several other additives that typically improve the dewatering characteristics of sludges, which also could have been tested, if enough raw sludge had been provided. Additionally, the additive dosage rate could have been optimized to produce a cake meeting the minimum pulp density requirements of 50 percent without using excessive polymer, thereby minimizing the processing cost to the customer.

The data from the lab test which resulted in a filter cake with a pulp density of 48% will be used to scale up to the full size process. Pilot scale tests using a one cubic foot filter press should be performed in the field to confirm and optimize the selected sludge pretreatment process.

The equipment identified to perform the dewatering of chlorinated and sludge should include:

- A nominal 100 cubic foot high pressure filter press with one inch membrane plates.
- A high pressure positive displacement pumping system to feed the filter press.
- A 60 degree cone bottom reaction tank for decanting, chemical addition and flocculation. A 60 degree cone bottom tank is recommended to prevent bridging of the flocculated material during chemical addition. The number of the tanks and capacity should be determined based upon availability at the time sludge dewatering is performed. The minimum recommended tank capacity is two (2) 2500 gallon tanks.

The consolidation and dewatering process should consist of the following steps:

1. Chlorinate and consolidate the pond sludge.
2. Transfer the sludge to the conical bottom reaction tank(s).
3. Add chemicals and mix the sludge until a "floc" is formed.
4. After flocculation the sludge will rapidly settle, decant the supernate
5. Pump the flocculated sludge into the filter press by a positive displacement pump until terminal pressure is achieved.
6. Inflate the high pressure membrane plates and compress the filter cake to release as much filtrate as possible.
7. Deflate the membrane plates, open the press and remove the cake. Note, this cycle should take 2 to 2½ hours for tasks 5 through 7 inclusive.

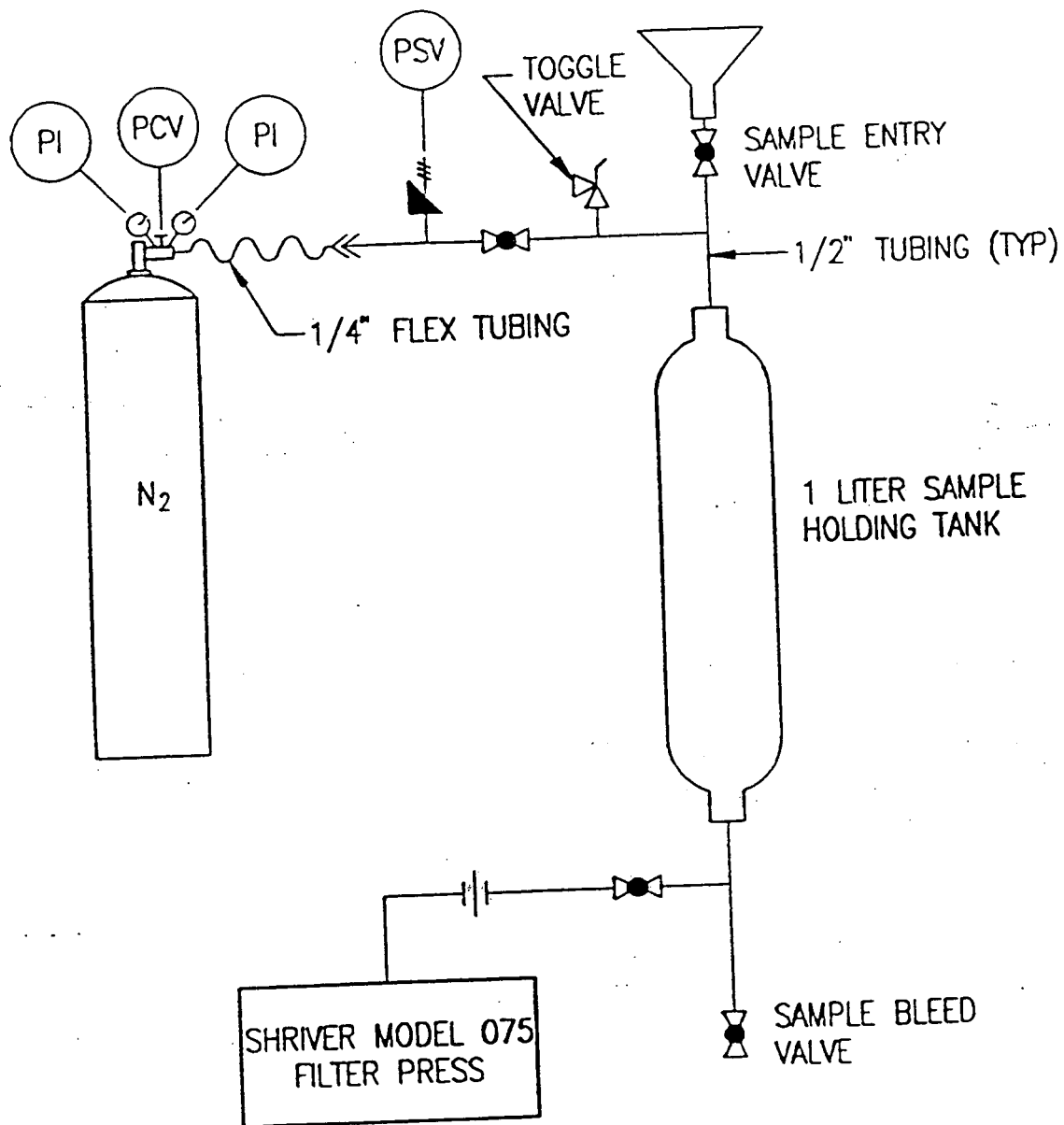


8. Discharge the filter cake from the press using a conveyer system.

Chlorination of the samples was performed by others prior to testing, therefore no recommendation can be made regarding chlorine dosage rates, residence times, or chlorination method.

Chemical addition should consist of a high molecular weight high charge cationic polymer. Actual dosage rates must be investigated further to achieve process optimization.

FIGURE 1  
TEST PRESS APPARATUS



# ATTACHMENT 1

## ROCKY FLATS BENCH TOP TEST PRESS DATA

EIMCO MODEL 075 PRESS - TEST #1 - DATE 2/25/92

### SLUDGE CHARACTERISTICS

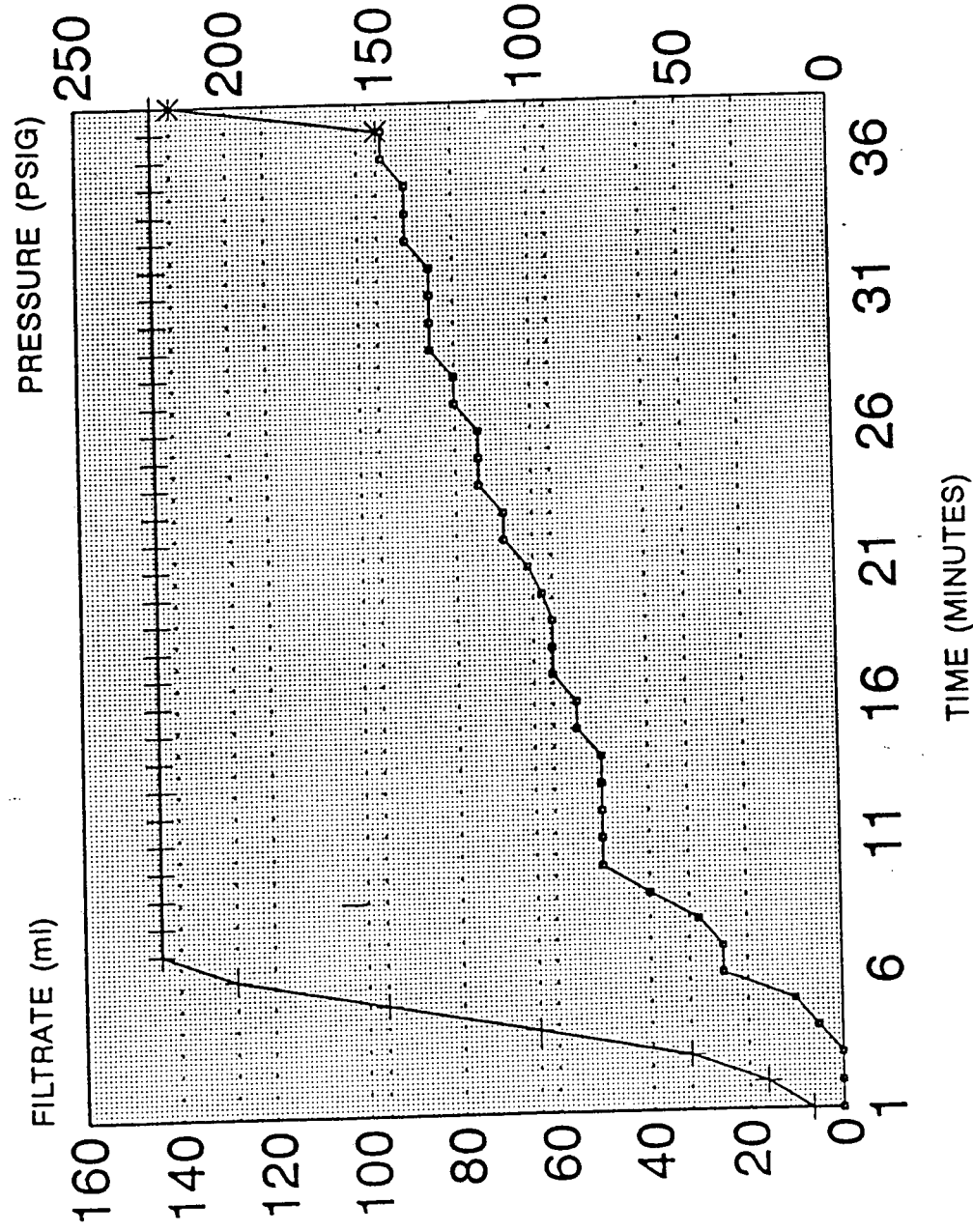
1. DENSITY: 1.003 g/l
2. PERCENT SOLIDS (BY WEIGHT): 7.9% (AFTER DECANT)
3. CHLORINATED (BY HNUS)
4. TEST ADDITIVES: NONE

TIME (minutes)	PRESSURE (psig)	FILTRATE (ml)
1	10	0
2	25	0
3	50	0
4	100	5
5	150	10
6	200	25
7	225	25
8	225	30
9	225	40
10	225	50
11	225	50
12	225	50
13	225	50
14	225	50
15	225	55
16	225	55
17	225	60
18	225	60
19	225	60

Attachment 1  
Rocky Flats De-Watering  
Test Data and Activity Report

TIME (minutes)	PRESSURE (psig)	FILTRATE (ml)
20	225	62
21	225	65
22	225	70
23	225	70
24	225	75
25	225	75
26	225	75
27	225	80
28	225	80
29	225	85
30	225	85
31	225	85
32	225	90
33	225	90
34	225	90
35	225	95
36	225	95
37	225	140
<b>PROCESSED WASTE</b> 320 ml	<b>CAKE WET</b> 22.9% SOLIDS	<b>TOTAL FILTRATE</b> 140 ml

# ATTACHMENT 1 TEST PRESS TEST-1 DATE 2/25/92



TEST PRESS, 1" CHAMBER, PP-925 CLOTH, NO PRETREATMENT  
 SLUDGE 7.89% SOLIDS, DENSITY 1.003 g/ml  
 CAKE SLOPPY INCOMPLETE 22.9% SOLIDS

## **ATTACHMENT 2**

### **ROCKY FLATS BENCH TOP DE-WATERING TEST**

#### **BAROID MUD PRESS - TESTS #1 & #2 - DATE 2/26/92**

##### **SLUDGE CHARACTERISTICS**

1. DENSITY: 1.0003 G/L
2. PERCENT SOLIDS (BY WEIGHT): 2.8% (BEFORE DECANT)
3. PERCENT SOLIDS (BY WEIGHT): 7.9% (AFTER DECANT)
4. CHLORINATED (BY HNUS)

##### **TEST ADDITIVES & AMOUNTS**

1. NALCO 7139 @ 0.5% SOLUTION ADDED AT 200 PPM  
HIGH MOLECULAR WEIGHT INTERMEDIATE CHARGE  
(FLOC LARGE WITH GOOD FILTRATE RELEASE)
2. NALCO 7194 @ 0.5% SOLUTION ADDED AT 280 PPM  
HIGH MOLECULAR WEIGHT HIGH CHARGE  
(FLOC SMALL WITH GOOD FILTRATE RELEASE)

##### **TEST #1 (7139)**

100 ML TREATED SAMPLE  
APPLIED 100 psi TO TEST APPARATUS  
BLOWDOWN IN 21 SECONDS  
RETRIEVED 85 ML FILTRATE  
PERCENT SOLIDS: 27.5%

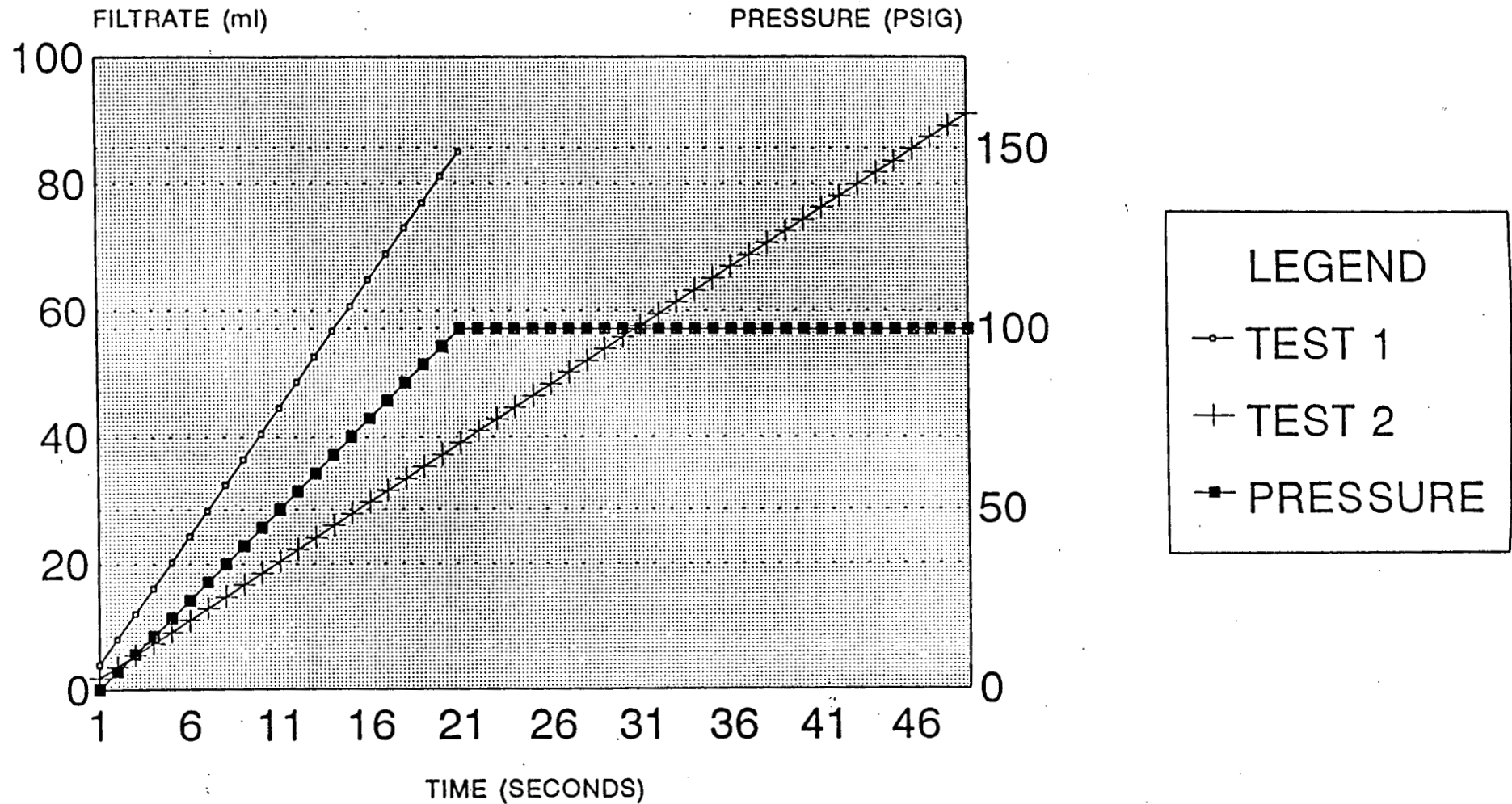
##### **TEST #2 (7194)**

100 ML TREATED SAMPLE  
APPLIED 100 psi TO TEST APPARATUS  
BLOWDOWN IN 49 SECONDS  
RETRIEVED 91 ML FILTRATE  
PERCENT SOLIDS: 34.9%

# ATTACHMENT 2

## TEST BOMB TEST-1 & TEST-2 COMPARISON

DATE 2/26/92



2

BAROID MUD PRESS, CLOTH NY-45cfm,  
SLUDGE 7.89% SOLIDS, DENSITY 1.003 g/ml  
TEST 1 27.5% SOLIDS TEST 2 34.9% SOLIDS

### ATTACHMENT 3

#### ROCKY FLATS BENCH TOP TEST PRESS DATA

EIMCO MODEL 075 PRESS - TEST #2 - DATE 2/26/92

#### SLUDGE CHARACTERISTICS

1. DENSITY: 1.0003 G/L
2. PERCENT SOLIDS (BY WEIGHT): 7.9% (AFTER DECANT)
3. CHLORINATED (BY HNUS)
4. TEST ADDITIVE & AMOUNT  
NALCO 7139 @ 0.5% SOLUTION 200 PPM ADDITION

TIME (minutes)	PRESSURE (psig)	FILTRATE (ml)
1	50	320
2	50	380
3	50	460
4	50	540
5	50	580
6	100	710
7	100	715
8	100	750
9	100	775
10	100	790
11	150	825
12	150	850
— 13	150	865
14	150	880
15	150	900
16	200	925
17	200	940
18	200	955



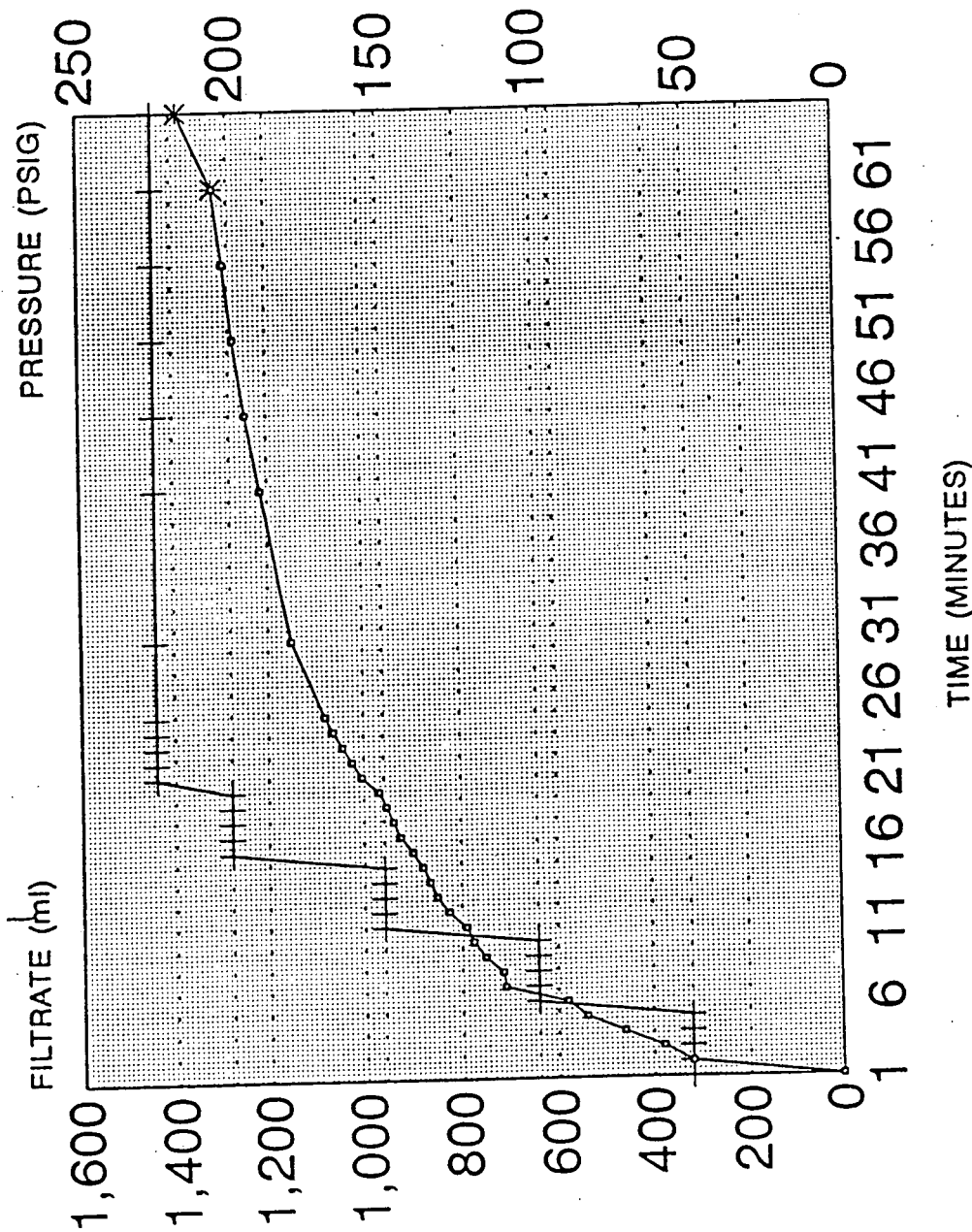
Attachment 3  
Rocky Flats De-Watering  
Test Data and Activity Report

TIME (minutes)	PRESSURE (psig)	FILTRATE (ml)
19	200	970
20	200	985
25	225	1080
30	225	1150
35	225	1175
40	225	1215
45	225	1245
50	225	1270
55	225	1290
60	225	1310
65	225	1385
<b>PROCESSED WASTE</b> 1650 ml	<b>CAKE FIRM</b> 35.4% SOLIDS	<b>TOTAL FILTRATE</b> 1385 ml

# ATTACHMENT 3

## PRESS TEST TEST-2

DATE 2/26/92



TEST PRESS, 1" CHAMBER, CLOTH NY-45 cfm, NALCO 7139 .5% @ 200PPM  
SLUDGE 7.89% SOLIDS, DENSITY 1.003 g/ml  
CAKE FIRM, 35.4 % SOLIDS

ROCKY FLATS  
BENCH TOP TEST DATA

EIMCO MODEL 075 PRESS - TEST #3 - DATE 2/26/92

SLUDGE CHARACTERISTICS

1. DENSITY: 1.0003 G/L
2. PERCENT SOLIDS: 7.9% (AFTER DECANT)
3. CHLORINATED (BY HNUS)
4. TEST ADDITIVE & AMOUNT  
NALCO 7194 @ 0.5% SOLUTION 280 PPM ADDITION  
6 G/L DIATOMITE FILTERAID

TIME (minutes)	PRESSURE (psig)	FILTRATE (ml)
1	50	10
2	50	60
3	50	90
4	50	110
5	50	140
6	100	220
7	100	270
8	100	310
9	100	335
10	100	370
11	150	420
12	150	450
13	150	475
14	150	500
15	150	530
16	200	580

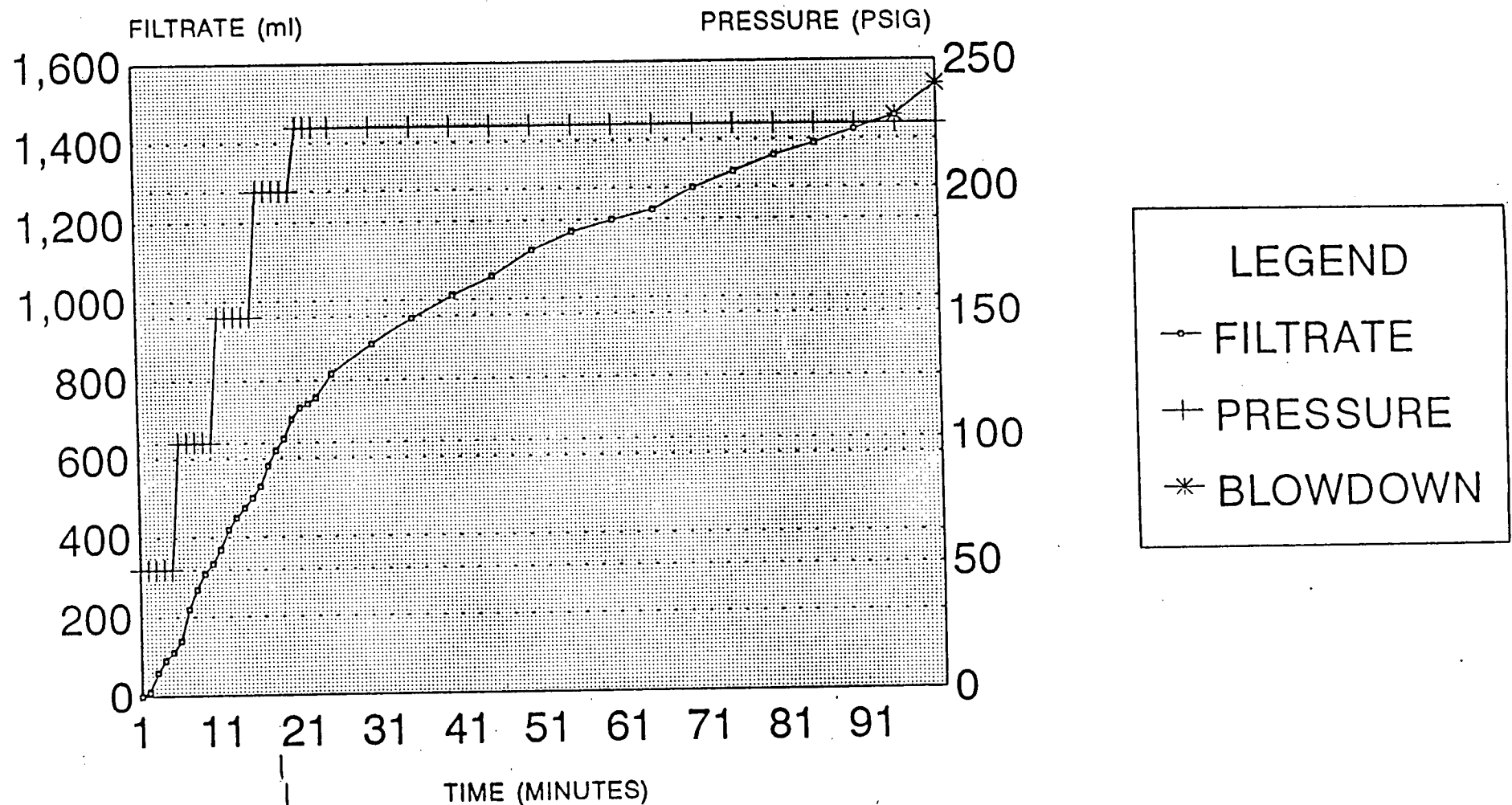
Attachment 3  
Rocky Flats De-Watering  
Test Data and Activity Report

TIME (minutes)	PRESSURE (psig)	FILTRATE (ml)
17	200	620
18	200	650
19	200	700
20	200	730
21	225	740
22	225	755
23	225	815
25	225	890
30	225	955
35	225	1010
40	225	1060
45	225	1125
50	225	1170
55	225	1200
60	225	1225
65	225	1280
70	225	1320
75	225	1360
80	225	1390
85	225	1425
90	225	1460
95	225	1480
96	225	1540
PROCESSED WASTE 1710 ml	CAKE FIRM 48% SOLIDS	TOTAL FILTRATE 1540 ml

# ATTACHMENT 3

## PRESS TEST TEST-3

DATE 2/26/92

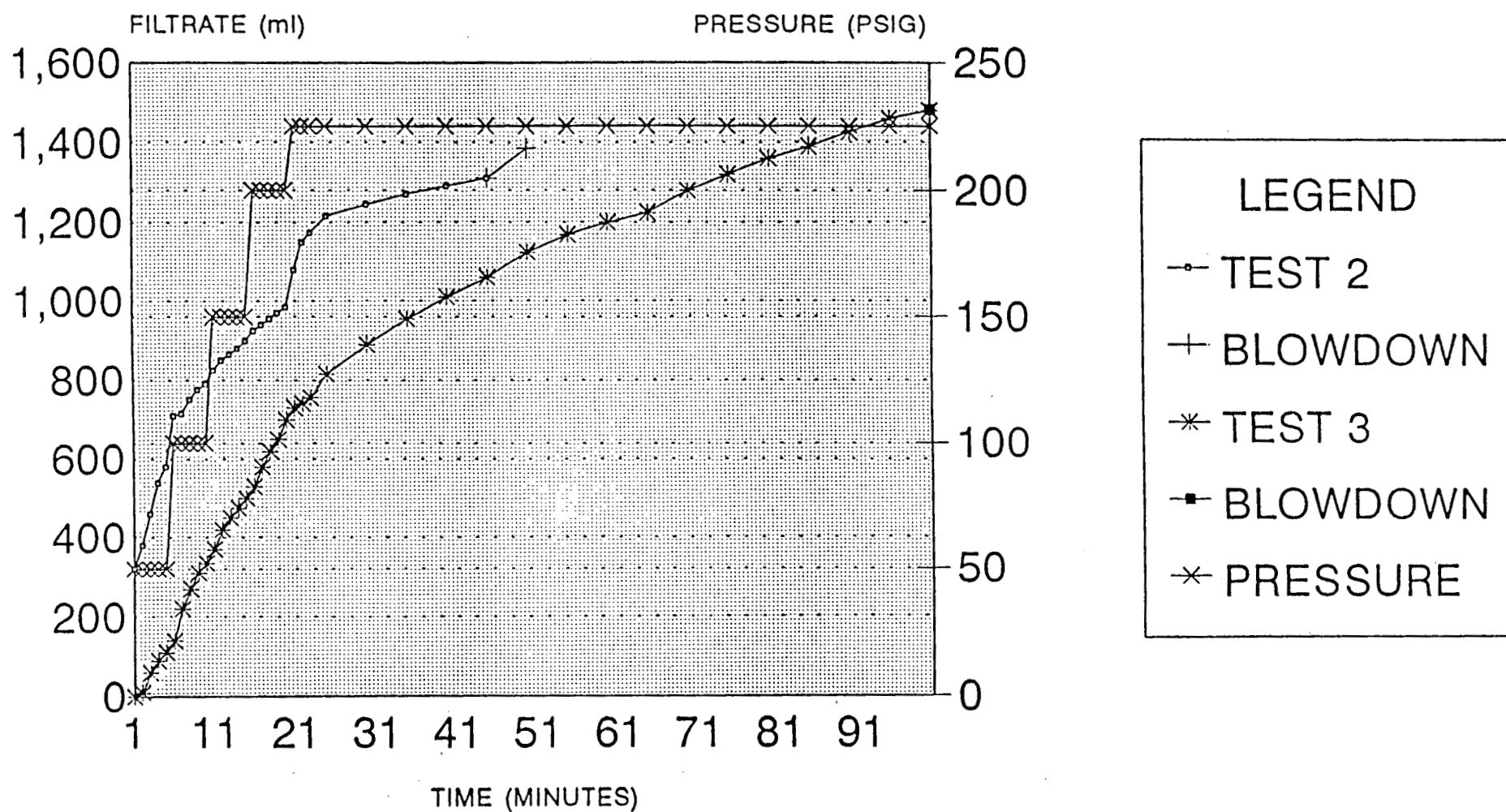


TEST PRESS 1" CHAMBER, CLOTH NY-45cfm, NALCO 7194 .5% @280PPM  
SLUDGE 7.89% SOLIDS, DENSITY 1.003 g/ml  
CAKE FIRM 48% SOLIDS

# ATTACHMENT 3

## PRESS TEST TEST-2 & TEST-3 COMPARISON

DATE 2/26/92



TEST PRESS 1" CHAMBER, CLOTH NY-45cfm  
SLUDGE 7.89% SOLIDS, DENSITY 1.003 g/ml  
CAKE: TEST 2,34.9% /TEST 3,48 % SOLIDS

**APPENDIX A**  
**LABORATORY LOG BOOK**

EST #1  
TAVT 10:23  
2/25/42

Decanted Sludge  
20 Solids 7.89  
770 Additions

me	Sludge	PST	F: Hydrate
1	700 ml Added	10	0
2		25	0
3		50	0
4		100	5
5		150	10
6		200	25
7		225	25
8		225	30
9			40
10			50
11			50
12			50
13			50
14			50
15			55
16			55
17			60
18			60
19			60 -
20			62
21			65
22			70
23			70
24			75
25			75
...			75



## REFILL RESERVATION

JALCO 7194 @ 280 ppm IN 5% SOLUTION, D/C @ 3.0/500 ml  
 450 FM NYLON CLOTH  
 7.82% Solids DECANT  
 = 65% LITER

TEST 7194-001  
 PAGE 1

MINUTES	PSI	ML WASTE	TOTAL WASTE	FILTRATE START	FILTRATE ML	TOTAL FILTRATE	NOTES
	50	500	500 ml	<del>N/A</del>	N/A	N/A	3.0% D/C 1500 ML SOLIDS N 7194 @ 280 PPM
					10		
					60		
					90		
					110		
	100				140		
					220		
					270		
7:39		500	1,000		310	310	REFILL RESERVOIR
				0	25	335	
	150				60	370	
					110	420	
					140	450	
					165	475	
					190	500	
	200				220	530	
					270	580	
					310	620	
					340	650	
					365	700	
						730	
	225				390	730	
20:13		500	1,500		420	730	REFILL RESERVOIR
					10	740	
					25	765	
						755	
					85	850	
30					160	1010	
35					225	1235	95
40					290	1510	100

NOTES	PSI	WASTE	WASTE TOT	Filtrate START	Filtrate ml	Filtrate TOT															
						1150															
3:42	225	500ml	2000ml	0	25	1175															
4:00					65	1245															
4:00					95	1245															
4:00					120	1270															
5:00					140	1290															
5:20					160	1310															
6:00					N/C 160	1310															
OFF		<350>	1650		E/O	1335															
<p>Blowdown DATA: @ 6 minutes</p> <table> <tr> <td>Filtrate Vol.</td> <td>Finish</td> <td>235</td> </tr> <tr> <td>"</td> <td>START</td> <td>160</td> </tr> <tr> <td colspan="2"></td> <td>75</td> </tr> </table> <p> <math>\Delta</math>            FILTRATE            Blow Down            TOT. FILTRATE         </p> <table> <tr> <td>1310</td> </tr> <tr> <td><u>75</u></td> </tr> <tr> <td>1325</td> </tr> <tr> <td>1650</td> </tr> <tr> <td><u>1325</u></td> </tr> <tr> <td>325</td> </tr> </table> <p> <math>\frac{1325}{1650} = 80.30\%</math> </p> <p>CARE = 35.4% Solids → MICROWAVE</p>							Filtrate Vol.	Finish	235	"	START	160			75	1310	<u>75</u>	1325	1650	<u>1325</u>	325
Filtrate Vol.	Finish	235																			
"	START	160																			
		75																			
1310																					
<u>75</u>																					
1325																					
1650																					
<u>1325</u>																					
325																					

7139 @ 200 PPM ADDED 10 5% SOLUTION = 200 cc / 500 ml  
 45 CFM: NYLON CLOTH

Test: 7139-001  
 Page 4

MINUTES	TIME	PSI	Total shut	Notes	Filtrate ML	Total Filtrate
12:05		50		<del>Stop</del>	0	320
			1000	Add 500 ml		320
		50			0	<del>380</del> 60
						140
						220
		100				260
1:13		<del>100</del>	1500	Add 500 ml		390
					0	<del>405</del>
						40
						65
		150				80
						115
						140
						155
						170
		200				190
						215
						230
						245
						260
		225				275
						295
						315
						370
						425
						440

REFILL RES

REFILL RES

380

460

540

580

(710)

715

750

775

790

825

850

865

~~880~~

900

925

940

955

970

985

1005

1025

1045

1065

1080

1105

1150

1150

2-26-92

10:30 arrive AT HNUK

7139 } NALCO POLYMERS  
7194 } FOR TODAY'S WORK

CHLORINATION OF  
SLUDGE / WATER:

11:00 am Mud Press Set-up.

Test w/ 7139 Polymer 200 ppm .5% Solution  
7194 " 250 " " "

OTU

icfm / nylon 100 ml / ounce of 789% decant sludge

30 PSI

#1 w/ 7139

#2 w/ 7194 11:38:30

1. 21 sec for 100 ml

2. Retrieve 85 ml

3.

4. 21 sec to release

5. 85 ml from 100 ml

6. TEST.

7.

8. 27 1/2 % Solids

9.

10.

49 sec Run to Release

91  
85 ml from 100 ml sample

34.9 % Solids

11<sup>00</sup> am: Opened Press → Sloppy Cake

Sample given to HNUIS to run % Solids

% Solids Analysis

As Received 2.8%

Run 22.9% — test #1 / decanted Sludge no additives

Decant Sludge: 7.89%

S.T. #1 cont.

[illegible]